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(54) Ratio selector system using fluid actuators and ectrohydraulic control in a vehicle transmission

(57) A ratio selector mechanism 29 is operated by a first fluid operable actuator 18 for selecting a required ratio, and a second actuator 23 arranged to effect a movement along neutral path whereby at one or more selected positions along that path the first actuator can select the required ratio by movement transverse to that path. Potentiometers 30, 32 are provided by which the positions of output members 22, 26 of the actuators can be determined to provide feedback signals for a control system 10. First and second proportional solenoid valves 16, 17 for controlling the respective first and second actuators are provided and the control system is arranged to control the first and second valves so as to vary the fluid flow through the valves in response to the respective feedback signals as the output members of the associated actuators approach their final positions when selecting a ratio.

FIG. 1.

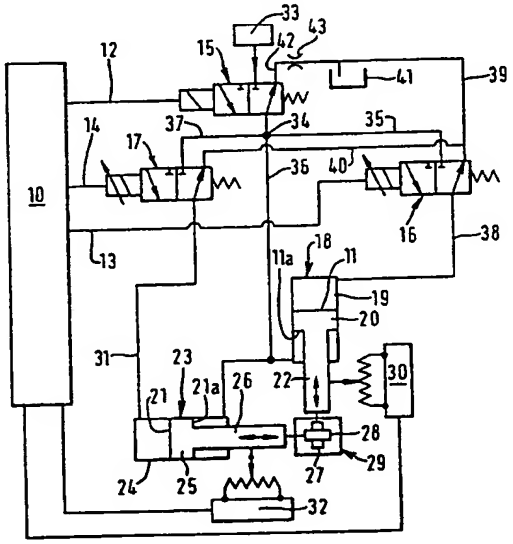

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FIG. 1.

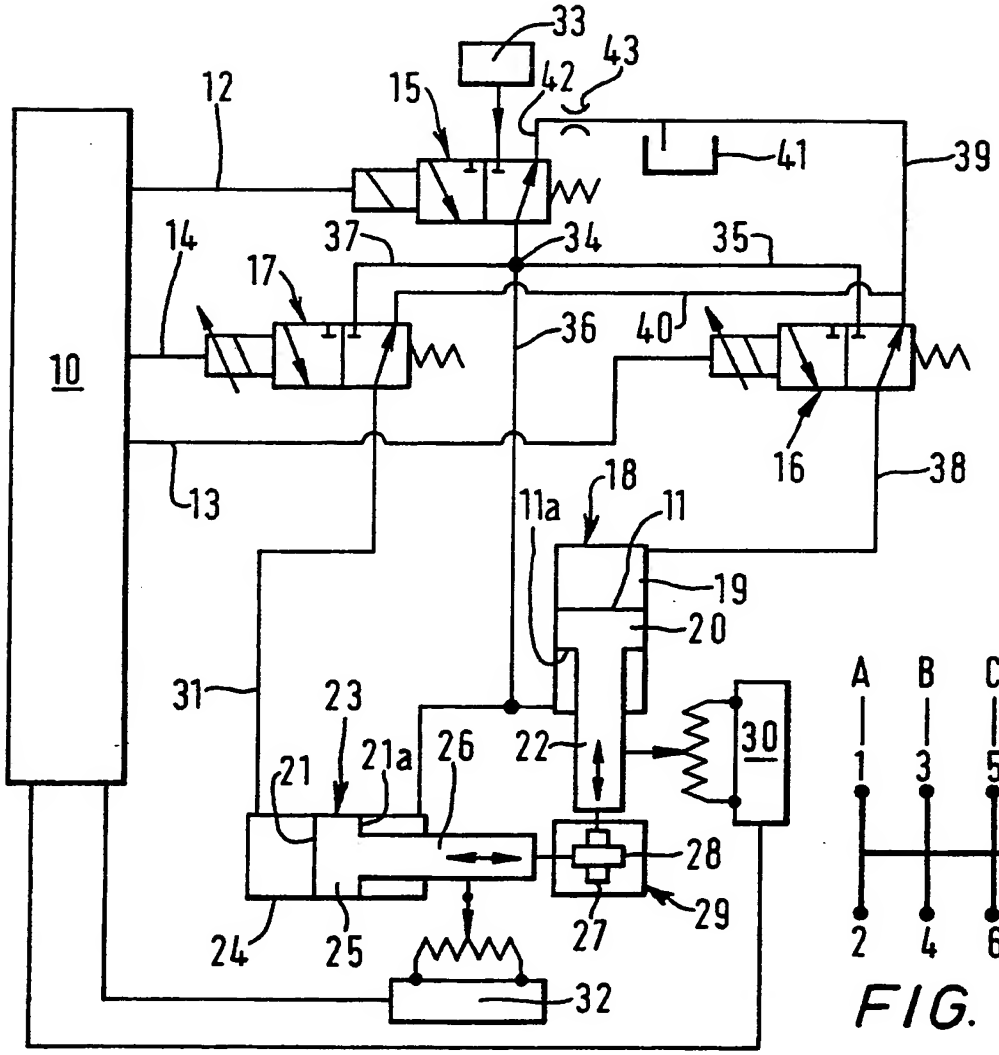

FIG. 2.

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FIG. 3.

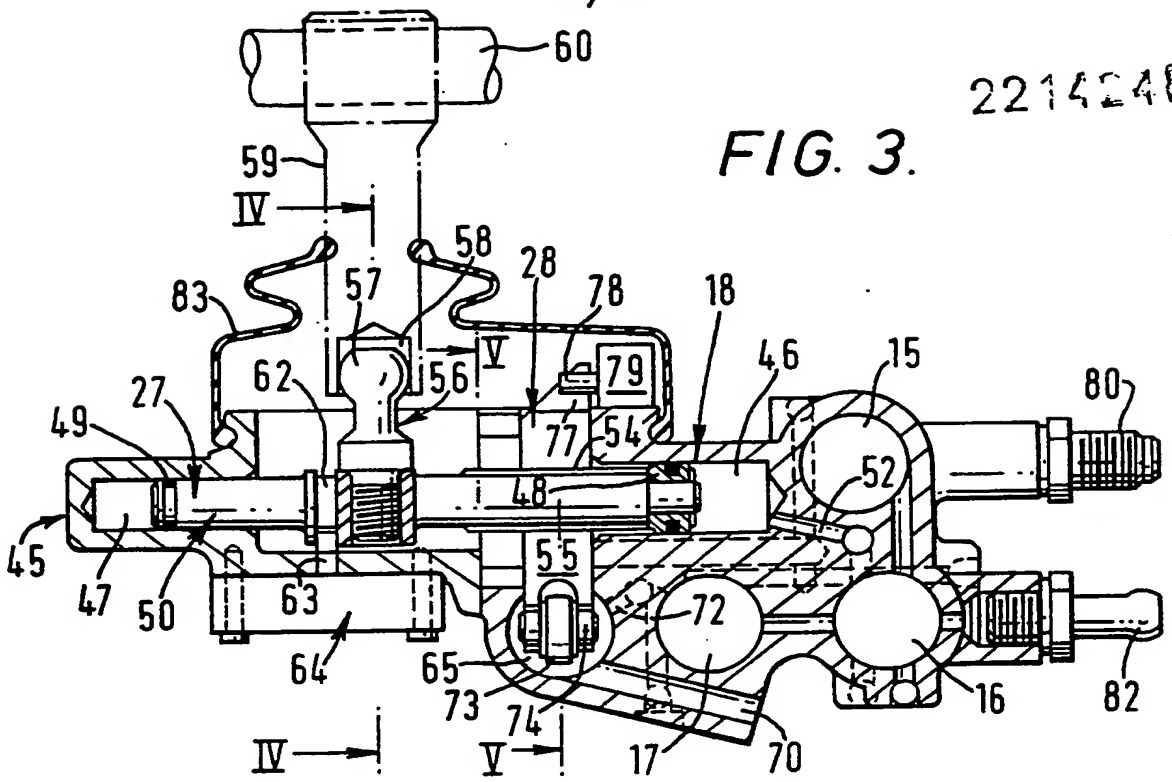

FIG. 4.

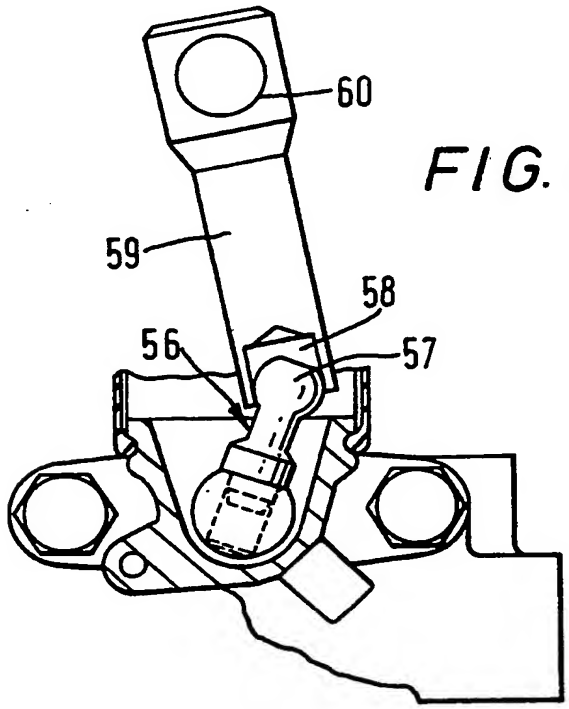

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FIG. 5.

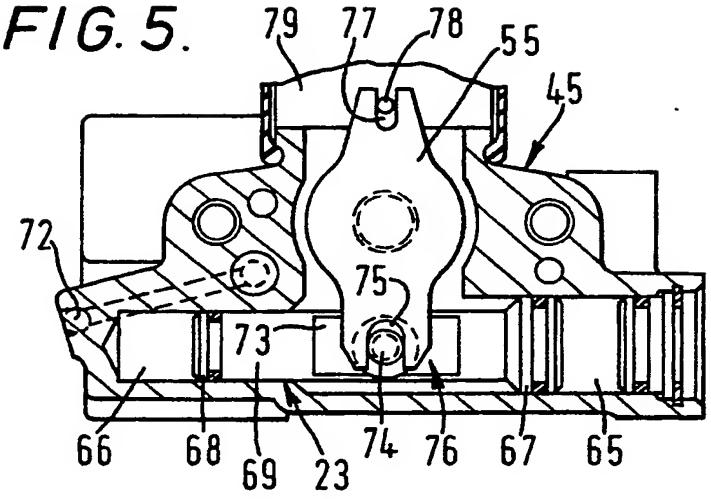

FIG. 6.

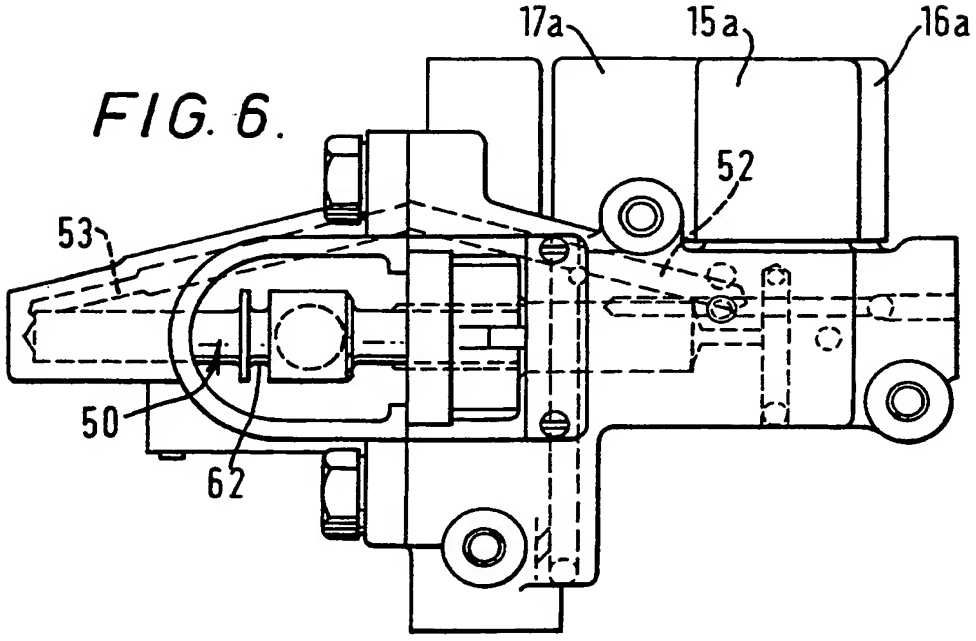

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FIG. 7.

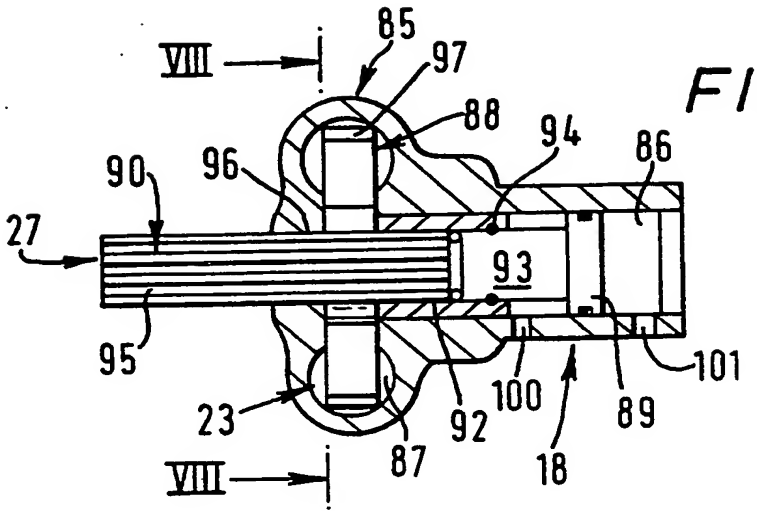


FIG. 8.

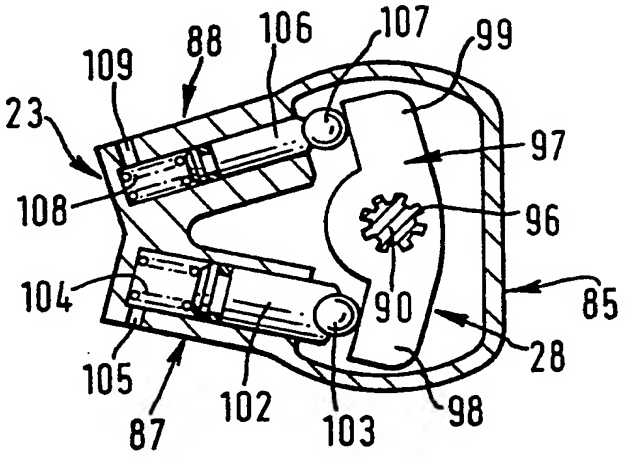
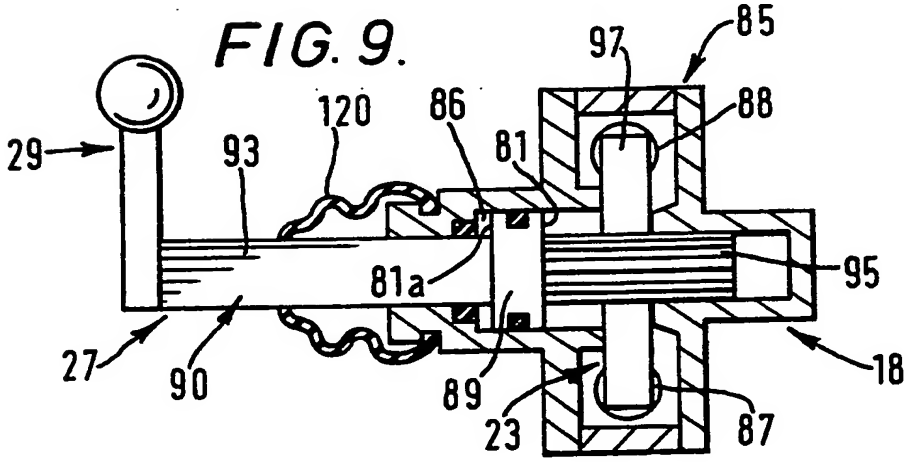


FIG. 9.



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SELECTION OF RATIOS IN A VEHICLE TRANSMISSION

The invention relates to the selection of ratios in a vehicle transmission using fluid operable actuator means.

It has been proposed hitherto to select ratios in a vehicle transmission by means of fluid operable actuators. However, known systems are complex involving many control valves by means of which a selector mechanism effects a ratio change by shifting from a neutral condition into which the transmission is biased. Examples of such a system are described in GB-A-2166208 and GB-A-995788 where each actuator in the system requires two independently operable solenoid valves to control fluid flow to and from its cylinder. GB-A-1099404 also describes such a system where an even higher number of solenoid valves are required to effect ratio selection. An object of the present invention is to provide a simplified yet effective system for selecting ratios.

According to one aspect of the invention there is provided a ratio selector system for a vehicle transmission comprising a ratio selector mechanism, a first fluid operable actuator for selecting a required ratio, a second actuator arranged to effect a movement along a neutral path whereby at one or

more selected positions along that path the first actuator can select the required ratio by a movement transverse to that path, sensing means by which the positions of output members of the actuators can be determined to provide feedback signals for a control system, and first and second valves for controlling the respective first and second actuators, the control system being arranged to control the first and second valves so as to vary the fluid flow through the valves in response to the respective feedback signals as the output members of the associated actuators approach their final positions when selecting a ratio.

With such a system the number of valves required per actuator is reduced thereby providing a more simple arrangement than those of the prior art. Moreover the control of the fluid flow as the output member of the associated actuators approach their final positions provides fine control over the output members of the actuators towards the ratio selection positions. The actuators work in harmony to select ratios which, may, for example, be in conventional H-gate or other suitable configuration.

According to a further aspect of the invention there is provided a ratio selection system for a vehicle

transmission comprising a ratio selector mechanism, first and second fluid operable actautors for operating said ratio selector mechanism, valve means for controlling actuation for the first and second actuators, a control system for controlling the valve means and sensing means by which the positions of output members of the actuators can be determined to provide feedback signals for the control system.

The output members of the actuators may be associated with respective first surfaces against which fluid acts for moving the output members in one direction and respective second surfaces having areas different from those of the first surfaces against which fluid acts for moving the output members in the opposite direction. The surfaces may be provided by pistons on piston rods which form the output members.

Preferably the first and second valves are controlled so as to effect a pressure balance across those areas of the associated actuators to prevent further movement of the output members once the final positions have been reached.

Preferably a main control valve is provided which controls fluid flow to said first and second valves.

A ratio may be engaged by commanding the control system to select the required ratio, using the control system to operate the main control valve to pressurize the system, using the control system to control the second valve where a shift along the neutral path is required for the ratio to be engaged, and then using the control system to control the first valve to engage the ratio.

Preferably the main control valve is operated by the control system to permit a pressure drop in the system once the desired ratio has been engaged.

Preferably proportional valves by which flow of fluid therethrough to the respective actuators is controlled in response to the feedback signals from the sensing means. The use of the detent means that a drop in system pressure as aforesaid will not cause the selected ratio to become disengaged.

The first and second valves may comprise proportional valves by which flow of fluid therethrough to the respective actuators is controlled in response to the feedback signals from the sensing means.

Preferably the sensing means comprise first and second transducers, e.g. potentiometers, which sense

the position of the output member of the first and second actuators.

According to another aspect of the invention there is provided a ratio selection device comprising housing containing two fluid operable actuators a first of which is arranged to effect axial movement of a first output member and a second of which has a second output member arranged to effect rotary movement of the first output member through an element which is slidably mounted on a portion of the first output member to permit axial movement of said portion of the first output member relative to the element, said actuators being operable in response to a control system to effect ratio selection.

According to yet another aspect of the invention there is provided a ratio selection device comprising a housing having a plurality of fluid operable actuators a first of which actuators is arranged to effect axial movement of a first output member of the device and a second of which has a second output member arranged to effect rotary movement of the output member, said actuators being operable in response to a control system to effect ratio selection.

Preferably the element is splined to said portion of the first output member to permit said axial movement of the portion of the first output member to take place relative to the element.

In one embodiment, at least one of the actuators comprises two spaced apart cylinders which have respective pistons on a common piston rod to form the first or second output member. In such a case each actuator may comprise two spaced apart cylinders which have respective pistons axially fast with a common piston rod to form the first and second output member. Preferably the piston in one cylinder has a cross section different from that of the piston in the other cylinder.

In another embodiment, the second actuator comprises a single piston axially fast with its output member and which divides a chamber into spaced apart cylinders. The piston may be formed on one end of or intermediate the ends of its output members. Preferably one side of the piston has a cross sectional area different from that of the other side.

The output member of the single piston may project axially from the housing.

The second actuator may comprise first and second operative sections lying side by side and having respective second output members for rotating the output member in one sense or an opposite sense. Preferably the output members rotate the first output member through respective radial arms of said element, said output member being arranged to apply forces to said radial arms.

The first and second operative sections may include respective first and second cylinders having second output members in the form of respective pistons therein whereby pressure applied in one of the cylinders causes relative movement to be effected between said one cylinder and its piston so as to rotate the first output member in one sense and whereby pressure applied in the other of the cylinders causes relative movement to be effected between said other cylinder and its piston so as to rotate the first output member in an opposite sense. Preferably the cylinders are inclined to each other.

Each piston may transmit drive to the first output member through a ball or like intermediate element. Such an intermediate member may be located in its associated piston. The piston may be normally biased by resilient means so as to hold the intermediate

member in position.

The output member may carry a driving finger which transmits drive to a ratio selector member. The driving finger may transmit drive to the ratio selector member through a ratio selector lever on the ratio selector member. Preferably the driving finger and the ratio selector lever pivotally engage each other whereby rotation of the driving finger in one sense will turn the ratio selector lever in an opposite sense but whereby axial movement of the first output member will cause the driving finger to transmit movement to the ratio selector lever without pivotal movement occurring.

The first output member may be axially fast with means for moving an operating member of a position sensing means.

The element for rotating the first output member may be arranged to move an operating member of a position sensing means.

The invention will now be described by way of example only with reference to the accompanying drawings in which:-

Fig.1 is a circuit diagram to illustrate the arrangement and operation of one form of ratio selection system in accordance with the invention,

Fig.2 is a diagram showing a typical gear shift patter,

Fig.3 is a longitudinal cross-section through one form of ratio selection device according to the invention,

Fig.4 is a cross-section of the device in Fig.3 on line IV-IV in Fig.2,

Fig.5 is a cross-section of the device in Fig.3 on line V-V in Fig.3,

Fig.6 is a plan view of part of the device shown in Fig.3,

Fig.7 is a longitudinal cross-section through another form of ratio selection device in accordance with the invention,

Fig.8 is a cross-section of the device in Fig.7 on the line VIII-VIII in Fig.7, and

Fig.9 is a longitudinal cross-section through a further form of ratio selection device in accordance with the invention.

In Fig.1 a control system 10 is provided which receives input signals from sensors (not shown) of known kind on the vehicle which provide the control system with a signal to command that a ratio change be made in the vehicle gear box. The control system 10 has outputs 12, 13 and 14 which operate a main control valve 15, a first actuator valve 16 and a second actuator valve 17, the two latter valves being of the proportional type. The system includes a first double acting actuator 18 comprising a cylinder 19, a piston 20 and a piston rod 22. The piston 20 has a large area 11 at one end and a relatively smaller area 11a at its opposite end. The system also includes a second double acting actuator 23 comprising a cylinder 24, a piston 25 and a piston rod 26. The piston 25 has a large area 21 at one end and a relatively smaller area 21a at its opposite end. The piston rods 22, 26 are operatively connected to first and second selector members 27, 28 of a ratio selector mechanism 29. The piston rods 22, 26 co-operate with respective linear or rotary potentiometers 30, 32. The potentiometers 30, 32 are

wired into a circuit in the control system 10 whereby on movement of the pistons 20, 25 as described below the control circuit 10 senses a change in signal resulting from the variation in potentiometer resistance.

Hydraulic fluid is supplied under pressure from a source 33 to the main control valve 15. The main control valve 15 is connected at 34 to an inlet line 35 for first actuator valve 16, to an inlet/outlet line 36 for the piston rod ends of the two cylinders 19, 24 and to an inlet line 37 for second actuator valve 17. The first actuator valve 16 communicates with the other end of cylinder 19 through a line 38 and the second actuator valve 17 communicates with the other end of cylinder 23 through a line 31. Exhaust ports of the first and second actuator valves 16, 17 communicate through lines 39, 40 with a sump 41 and the main control valve 15 communicates with the sump 41 via a line 42 and restrictor 43. The valves 10, 15 and 17 are biased normally into the positions shown.

A typical gear shift pattern is shown in Fig.2 and the first member 27 of the selector mechanism 29 is arranged to shift between the ratios 1 to 6 and R in the up and down direction as viewed in Fig.1 and the

second member 28 is arranged to move horizontally along a neutral path 43 to enable member 27 to select ratios at the positions A, B, C and D.

The operation of the system shown in Figs.1 and 2 will now be described.

On switching the ignition system of the vehicle into the "on" condition, the potentiometers 30, 32 enable the control system 10 to sense the position of the selector members 27, 28. If the member 27 is not on neutral path 43 the actuator 18 is operated as described below to position the selector member on the neutral path. The engine can then be started.

To move off from rest in first ratio, the main control valve 15 is shifted to the right following a signal from the control system 10 to pressure lines 35, 36 and 37. Outputs 13, 14 are applied to the actuator valves 16, 17 whereby fluid under pressure is admitted to the piston rod end (known as the small end) of cylinder 24 and applied to area 21a.

Piston 25 moves to the left as a result and fluid from the opposite end (known as the large end) of cylinder 24 escapes to the sump via line 31, actuator valve 17 and lines 40 and 39. The feedback from

potentiometer 32 is used by the control system 10 to sense when the selector member 28 is approaching the A position and the control system 10 controls the actuator valve 17. The actuator valve 17 is operated by the control system 10 so as to control pressure in line 31 by communication with appropriate lines 37 and 40 so that a pressure balance is obtained across the piston 25 when the A position is reached. If, therefore, the area 21 is twice area 21a the actuator valve 17 controls fluid in pressure line 31 until the pressure acting on area 21 is half that acting on area 21. In that way the piston 25 is held in the selected position by fluid pressure.

The control system 10 applies positioning control to actuator valve 16 so that as the actuator 23 operates to select the A position, pressure applied to the small end of cylinder 19 and thus to area 11a is unable to shift the piston upwardly as viewed. Once the A position is reached, the position of valve 16 is controlled so as to allow fluid to escape to sump from the large end of actuator 19 via lines 38, valve 16 and line 39. The feedback from potentiometer 30 is used by the control system 10 to sense when the selector member 27 is approaching the "first ratio engaged" position and the control system controls the actuator valve 16 so as to decrease the flow

therethrough to line 39. The actuator valve 16 is operated by the control system 10 so as to control pressure in line 38 by communication with appropriate lines 35, 39 so that a pressure balance is obtained across the piston 20 when the "first ratio engaged" position is reached. As in the case of actuator 24, if the area 11 is twice area 11a the actuator valve 17 controls fluid pressure in line 38 until the pressure acting on area 11 is half that acting on area 11a. The "first ratio engaged" position corresponds to that in which a mechanical detent in the gearbox holds the transmission in the selected ratio whereby it is then no longer necessary to hold the piston 20 in position by balanced fluid pressures. Also once the first ratio is selected the selector 28 will be prevented mechanically from moving out of the A position and balanced pressures are no longer required to hold the piston 25 in position. Therefore it is no longer necessary to maintain pressure in lines 35, 36 and 37 and valve 15 is returned to the position shown in Fig.1, control of the valves 16, 17 being maintained or modulated by the control system as pressure falls away to avoid any loss of control due to sudden pressure drop in lines 35, 36 and 37.

To shift from first ratio to second ratio the valve 15 is again shifted to the right to pressurize lines 35, 36 and 37. At the point of change the control system 10 commands movement of valve 16 to the right so that fluid under pressure is applied to both sides of piston 28. The differential loading on the piston 28 causes the piston to move downwardly, fluid in the small end of the cylinder 19 flowing through lines 36, 35 and 38 to the opposite end of the cylinder 19. The member 27 crosses over the neutral path 43 and eventually approaches a "second ratio engaged" position. As that position is approached, feedback from the sensor 30 is used by the control system 10 to control the actuator valve 16 so as to decrease applied to area 11 until a pressure balance is achieved across the piston as selector member 27 reaches the "second ratio engaged" position. During the shift from first ratio to second ratio, control of the actuator valve 17 maintains a pressure balance across piston 25 to ensure that position A is maintained. Once second ratio is engaged, the selector member 27 is held in position by the mechanical detent for holding second ratio and the control system 10 shifts valve 15 to the left while modulating valves 16, 17 to allow a fall in pressure in lines 35, 36 and 37 as before.

When the engine is switched off, the control system 10 may cause the valves 16, 17 to bring the selector members 27, 28 into the neutral path 43.

The selection of the remaining ratios follows a similar pattern with the actuator 23 being used to effect a shift along the neutral path 43 when, for example changing from second to third ratio.

Whilst the system described is primarily for use in automatically selecting ratios it could be adapted for use as a remote gear change control for a manual gearbox.

Reference is now made to Figs.3 to 6 which illustrate a ratio selector device incorporating the first and second actuators 18, 23 and the members 23, 28 in Figs.1.

The device includes a housing 45 which defines two spaced apart cylinders 46, 47 equivalent to the large and small ends respectively of actuator 18 in Fig.1 and which house respective pistons 48, 49 of different diameters at the ends of a piston rod 50 constituting the aforesaid first output member. The end surface area of piston 48 is, e.g., twice that of piston 49. The cylinder 46 communicates with an

inlet/outlet passage 52 and the cylinder 47 communicates with an inlet outlet passage 53. The piston rod 50 is equivalent to the piston rod 22 in Fig.1 and the inlet/outlet passageways 52, 53 are equivalent to 38, 36 in Fig.1. Fluid flow through the passageways is controlled by the first actuator valve 16 in the housing. A proportional solenoid 16a for the valve 16 is shown in Fig.6. The piston rod 50 is splined at 54 and passes slidably through a splined lever 55. The piston rod 50 is rotatably and axially fast with a finger 56 having a ball-shaped radially outer end 57. The end 57 slidably locates within a bore 58 in the lower end of a ratio selector lever 59. The upper end of the lever 59 is rotatably and axially fast with a ratio selector shaft 60 which forms part of the ratio selector mechanism 29 in Fig.1. The piston rod 50 has a peripheral groove 62 which locates an operating pin 63 of a linear potentiometer 64 equivalent to potentiometer 30 in Fig.1.

The housing 45 also defines two further cylinders 65, 66 equivalent to the large and small ends respectively of actuator 23 in Fig.1 and which house respective pistons 67, 68 of different diameters at the ends of a piston rod 69 (constituting the aforesaid second output member. The end surface area

of piston 67 is, e.g., twice that of piston 68. The cylinder 65 communicates with an inlet/outlet passage 70 and the cylinder 66 communicates with an inlet/outlet passage 72. The piston rod 69 is equivalent to piston rod 26 in Fig.1 and the inlet/outlet passageways 70, 72 are equivalent to 31, 36 in Fig.1. Fluid flow through the passageways is controlled by the second actuator valve 17 in the housing. A proportional solenoid 17a for the valve 17 is shown in Fig.6. The piston rod 69 has a reduced section 72 axially fast with a transverse pin 74. The pins 74 locate in recesses 75 formed in a bifurcated end 76 of the lever 55. The arm 55 has a slot 77 in its upper end which receives an operating member 78 of a linear potentiometer 79. The potentiometer 79 is equivalent to potentiometer 32 in Fig.1.

Flow of fluid to the valves 16, 17 is controlled by the main control valve 15 which is contained within the housing 45 and which has an operating solenoid 15a. An inlet from the source 33 is provided at 80 and an outlet to the sump 41 is provided at 82. The housing 45 carries an elastomeric boot 83 which engages the selector lever 59 to inhibit ingress of dust into the housing.

In use and with the system filled with hydraulic fluid bled of air, operation of the main control valve 15 and first and second actuator valve 16, 17 causes the first and second actuators 18, 27 to operate as described with respect to Fig.1.

By operating actuator valve 16 to control introduction of fluid under pressure into cylinder 46 and escape of fluid from cylinder 47, the piston rod 50 will move to the left as viewed in Fig.3, such movement being transmitted to the selector shaft 60 directly through the ratio selector lever 59 so as to move the shaft 60 axially to the left and select the desired ratio.

The shaft 60 moves relative to lever 55 by virtue of the splines 54. Opposite axial movement of the shaft 60 is effected by applying pressure to cylinder 47 and allowing fluid to escape from chamber 46. The axial movement of the shaft 60 corresponds to the vertical direction of the gear shaft pattern in Fig.2. The position of the piston rod 50 is sensed by the potentiometer 64.

Movement through the neutral path 43 to select the appropriate position A, B, C or D is achieved by operating actuator valve 17. By applying pressure to

cylinder 65 and controlling pressure of fluid in cylinder 66, the piston rod 69 will move to the left as viewed in Fig.5 such movement being transmitted through the lever 55 so as to rotate the piston rod 50. Such rotation is transmitted to the selector shaft 60 through the finger 56 and ratio selector lever 59 so as to return the shaft 60 about its longitudinal axis. The amount of movement transmitted to the shaft 60 will depend on the required movement along the neutral path 43. The distance moved by the piston rod 69 is sensed by the potentiometer 79 which is actuated by the slot 77 in the lever 55. In that way the appropriate position A, B, C or D can be selected at which position a pressure balance is achieved to hold the piston rod 69. Opposite axial movement of the piston rod 69 is effected by applying pressure to cylinder 66 and controlling pressure of fluid in cylinder 65 until a pressure balance is achieved when the desired position is reached.

Reference is now made to Figs.7 and 8 to illustrate another form of ratio selector device which incorporates the first and second actuators 18, 23 and the members 27, 28 in Fig.1.

The device includes a housing 85 which defines a double acting first cylinder 86 (corresponding to cylinder 19 of the first actuator 18 in Fig.1) and incorporates two single acting and mutually inclined second cylinders 87, 88 (corresponding collectively to the double acting cylinder 24 of the second actuator 23 in Fig.1), cylinder 87 being equivalent to the large end of cylinder 24 and cylinder 88 being equivalent to the small end of cylinder 24.

The cylinder 86 contains a piston 89 which is axially fast with a piston rod 90 (constituting the aforesaid first output member) mounted for rotary and axial sliding movement in a bore 92. The piston 89 has a large area 81 at one end and a relatively smaller area 81a at its opposite end, the area 81 being, e.g., twice that of area 81a. The piston rod 90 has a plain section 93 which engages a seal 94 on the housing 85 and a splined section 95 which locates slidably with a splined bore 96 of a lever 97 having two arms 98, 99. The lever 97 is held captive against axial movement within the housing. The cylinder 86 has inlet/outlet ports 100, 101, which, in use, connect to lines 38, 36 respectively in the Fig.1 system.

The cylinder 87 houses a piston 102 which has a ball bearing 103 located on its outer end. The piston 102 is biased axially by a light spring 104 so as to hold the bearing in engagement with the arm 98. The cylinder 87 has an inlet/outlet port 105 for fluid. The cylinder 88 is of smaller diameter than cylinder 87 and houses a piston 106 with ball bearing 107, a light spring 108 and an inlet/outlet 109. In use the inlets/outlets 105, 109 are connected to the lines 31, 36 in Fig.1. The end surface area of piston 102 is, e.g., twice that of piston 106. The pistons 102, 106 constituting second operating members.

The piston rod 90 is equivalent to member 27 in Fig.1 and the lever 97 is equivalent to member 28. Actuation of piston 89 moves the piston rod 90 axially relative to the lever 97 for the selection of the ratios and actuation of pistons 102, 106 will rotate the lever 97 and piston rod 90 to effect the shift along the neutral path 43.

In Fig.9 parts corresponding to parts in Figs.7 and 8 carry the same reference numerals. The device in Fig.9 differs from that in Figs.7 and 8 in that the splined section 95 of the piston rod 90 is contained wholly within the housing 85 and the plain section 93 extends out of the housing for connection to the

selector mechanism 29. An elastomeric boot 120 is provided between the piston rod 90 and the housing 85. The cylinders 87, 88 and lever 97 are provided as in Figs.7 and 8 and the device is connected into the Fig.1 circuit in the same way as the device in Figs.7 and 8.

It will be noted in Figs.7 to 9 that the piston 89 is of larger diameter than the pistons 102, 106. In that way, the working pressure in the system (which is the same for all cylinders) will generate a greater axial thrust on the piston 89 than on the pistons 102, 106. That feature is useful in that the thrust on the piston rod 90 needs to be sufficiently high to push through the sliding sleeve of a synchromesh gear selector when selecting the ratios whereas the pistons 102, 106 simply need to overcome the frictional resistance involved in shifting along the neutral path 43. If desired the pistons 48, 49 in Figs.3 to 6 can be of larger diameter than the respective pistons 67, 68 for the same purpose.

CLAIMS

1. A ratio selector system for a vehicle transmission comprising a ratio selector mechanism, a first fluid operable actuator for selecting a required ratio, a second actuator arranged to effect a movement along a neutral path whereby at one or more selected positions along that path the first actuator can select the required ratio by a movement transverse to that path, sensing means by which the positions of output members of the actuators can be determined to provide feedback signals for a control system, and first and second valves for controlling the respective first and second actuators, the control system being arranged to control the first and second valves so as to vary the fluid flow through the valves in response to the respective feedback signals as the output members of the associated actuators approach their final positions when selecting a ratio.

2. A ratio selection system according to Claim 1 in which the output members of the actuators are associated with respective first surfaces against which fluid acts for moving the output members in one direction and respective second surfaces having areas different from those of the first surfaces against

which fluid acts for moving the output members in the opposite direction.

3. A ratio selection system according to Claim 2 in which the first and second valves are controlled so as to effect a pressure balance across those areas of the associated actuators to prevent further movement of the output members once the final positions have been reached.

4. A ratio selection system according to Claim 1, 2 or 3 in which a main control valve is provided which controls fluid flow to said first and second valves.

5. A ratio selection system according to Claim 4 in which a ratio is engaged by commanding the control system to select the required ratio, using the control system to operate the main control valve to pressurise the system, using the control system to operate the second valve where a shift along the neutral path is required for the ratio to be engaged, and then using the control system to control the first valve to engage the ratio.

6. A ratio system according to Claim 4 or 5 in which the main control valve is operated by the

control system to permit a pressure drop in the system once the desired ratio has been engaged.

7. A ratio selection system according to any of Claims 1 to 6 in which the final position of the output member of the first actuator when selecting a ratio corresponds to that in which a mechanical detent in the transmission holds the transmission in the selected ratio.

8. A ratio selection system according to any preceding claim in which the first and second valves are proportional valves by which flow of fluid therethrough to the respective actuators is controlled in response to the feedback signals from the sensing means.

9. A ratio selection system according to any preceding claim in which the sensing means comprise first and second transducers which sense the position of the output members of the first and second actuators.

10. A ratio selection device comprising a housing containing two fluid operable actuators a first of which is arranged to effect axial movement of a first output member and a second of which has a

second output member arranged to effect rotary movement of the first output member through an element which is slidably mounted on a portion of the first output member to permit axial movement of said portion of the first output member relative to the element, said actuators being operable in response to a control system to effect ratio selection

11. A ratio selection device according to Claim 10 in which the element is splined to said portion of the first output member to permit said axial movement of the portion of the first output member to take place relative to the element.

12. A ratio selection device according to Claim 10 or 11 in which at least one of the actuators comprises two spaced apart cylinders which have respective pistons axially fast with a common piston rod to form the first or second output member.

13. A ratio selection device according to Claim 12 in which each actuator comprises two spaced apart cylinders which have respective pistons axially fast with a common piston rod to form the first and second output member.

14. A ratio selection device according to Claim 12 or 13 in which the piston in one cylinder has a cross section different from that of the piston in the other cylinder.

15. A ratio selection device according to Claim 12 in which the other actuator comprises a single piston axially fast with its output member and which divides a chamber into spaced apart cylinders.

16. A ratio selection device according to Claim 15 in which the piston is formed on one end of or intermediate the ends of its output member.

17. A ratio selection device according to Claim 15 or 16 in which one side of the piston has a cross sectional area different from that of the other side.

18. A ratio selector device according to Claim 15, 16 or 17 in which its output member projects axially from the housing.

19. A ratio selection device according to Claim 10, 11 or 12 in which the second actuator comprises first and second operative sections lying side by side and having respective second output members for rotating the output member in one sense or an

opposite sense.

20. A ratio selection device according to Claim 19 in which the output members rotate the first output member through respective radial arms of said element, said output member being arranged to apply forces to said radial arms.

21. A ratio selection device according to Claim 19 or 20 in which the first and second operative sections include respective first and second cylinders having second output members in the form of respective pistons therein whereby pressure applied in one of the cylinders causes relative movement to be effected between said one cylinder and its piston so as to rotate the first output member in one sense and whereby pressure applied in the other of the cylinders causes relative movement to be effected between said other cylinder and its piston so as to rotate the first output member in an opposite sense.

22. A ratio selector according to Claim 21 in which the cylinders are inclined to each other.

23. A ratio selector device according to any of Claims 19 to 22 in which each piston transmits drive to the first output member through a ball or like

intermediate element.

24. A ratio selector according to Claim 23 in which the intermediate element is located in its associated piston.

25. a ratio selection device according to Claim 23 or 24 in which the piston is normally biased by resilient means so as to hold the intermediate member in position.

26. A ratio selection device according to any of Claims 10 to 25 in which the first output member carries a driving finger which transmits drive to a ratio selector member.

27. A ratio selection device according to Claim 26 in which the driving finger transmits drive to the ratio selector member through a ratio selector lever on the ratio selector member.

28. A ratio selection device according to Claim 27 in which the driving finger and the ratio selector lever pivotally engage each other whereby rotation of the driving finger in one sense will turn the ratio selector lever in an opposite sense but whereby axial movement of the first output member will cause the

driving finger to transmit movement to the ratio selector lever without pivotal movement occurring.

29. A ratio selection device according to any of Claims 10 to 28 in which the first output member is axially fast with means for moving an operating member of a position sensing means.

30. A ratio selection device constructed according to any of Claims 10 to 29 in which the element for rotating the first output member is arranged to move an operating member of a position sensing means.

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